

Exhibit B

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Surfactant

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A member of the class of materials that, in small quantity, markedly affect the surface characteristics of a system; also known as surface-active agent. In a two-phase system, for example, liquid-liquid or solid-liquid, a surfactant tends to locate at the interface of the two phases, where it introduces a degree of continuity between the two different materials. Soaps and detergents are classic examples of surfactants due to their dual (amphipathic) character. These substances consist of a hydrophobic tail portion, usually a long-chain hydrocarbon, and a hydrophilic polar head group, which is often ionic. A material possessing these characteristics is known as an amphiphile. It tends to dissolve in both aqueous and oil phase and to locate at the oil-water interface. *See also* Interface of phases; Soap.

Surfactants are employed to increase the contact of two materials, sometimes known as wettability. Surfactants and surface activity are controlling features in many important systems, including emulsification, detergency, foaming, wetting, lubrication, water repellance, waterproofing, spreading and dispersion, and colloid stability. *See also* Emulsion; Micelle.

In general, surfactants are divided into four classes: amphoteric, with zwitterionic head groups; anionic, with negatively charged head groups; cationic, with positively charged head groups; and nonionic, with uncharged hydrophilic head groups. Those with anionic head groups include long-chain fatty acids, sulfosuccinates, alkyl sulfates, phosphates, and sulfonates. Cationic surfactants may be protonated long-chain amines and long-chain quaternary ammonium compounds. The class of amphoteric surfactants is represented by betaines and certain lecithins, while nonionic surfactants include polyethylene oxide, alcohols, and other polar groups.

Quite different materials, such as polymers and clays, can also exhibit surface activity; many polymeric materials, for example, polyvinyl alcohol and polyacrylamide, are excellent stabilizers for a variety of colloid systems. These entities adsorb at the colloid interface and, by means of steric effects, prevent colloid-colloid adhesion and flocculation. Clays readily adsorb other materials or adsorb onto large particles suspended in solution, so that the particle interface consists of charged clay particles, which increase colloid stability by electrostatic and steric effects. *See also* Adsorption; Colloid; Ion exchange; Polymer; Surface and interfacial chemistry.